

CLAIMS

What is claimed is:

1 1. A system for protecting a network comprising:  
2 a plurality of links located in said network;  
3 a transmitter switch, coupled to a first end of each link of said plurality  
4 of links, for transmitting distinct data along each link of said plurality of links;  
5 and  
6 a receiver switch, coupled to a second end of each link of said plurality of  
7 links, for receiving said distinct data from each link of said plurality of links;  
8 wherein said distinct data transmitted along one link of said plurality of  
9 links is switched to another link of said plurality of links when a failure is  
10 detected on said one link.

1 2. The system according to claim 1, wherein said network is an  
2 Asynchronous Transfer Mode (ATM) network.

1 3. The system according to claim 1, wherein said network is a Frame  
2 Relay network.

1 4. The system according to claim 1, wherein said transmitter switch  
2 further comprises a transmitter line card coupled to said first end of each link of  
3 said plurality of links.

1 5. The system according to claim 4, wherein said distinct data  
2 transmitted along each link of said plurality of links comprises cells.

1 6. The system according to claim 5, wherein said transmitter line  
2 card further comprises a transmitter classifier module for classifying said cells  
3 transmitted along each link of said plurality of links, a plurality of transmitter

4 queuing buffers coupled to said classifier module, for receiving and storing said  
5 cells, and a transmitter multiplexing module coupled to each buffer of said  
6 plurality of transmitter queuing buffers and to each link of said plurality of  
7 links, for directing said cells stored in each buffer in a predetermined order to a  
8 corresponding link of said plurality of links.

1 7. The system according to claim 6, wherein said transmitter switch  
2 receives a virtual connection setup request and assigns at least one virtual  
3 connection corresponding to said virtual connection setup request alternatively  
4 to each buffer of said plurality of transmitter queuing buffers.

1 8. The system according to claim 7, wherein said at least one virtual  
2 connection is associated with said cells transmitted along each link of said  
3 plurality of links.

1 9. The system according to claim 7, wherein said transmitter switch  
2 assigns said at least one virtual connection to each buffer of said plurality of  
3 transmitter queuing buffers in such a way so as to ensure that each link has a  
4 balanced load.

1 10. The system according to claim 8, wherein said transmitter  
2 classifier module allocates said cells to each buffer of said plurality of  
3 transmitter queuing buffers based on association with said at least one virtual  
4 connection, in such a way so as to ensure that each link has a balanced load.

1 11. The system according to claim 6, wherein each buffer of said  
2 plurality of transmitter queuing buffers includes a plurality of Quality of  
3 Service (QoS) category queues.

1           12.    The system according to claim 6, wherein said transmitter line  
2 card further comprises a transmitter processor for monitoring each link of said  
3 plurality of links and for programming said transmitter multiplexing module to  
4 switch said distinct cells transmitted along said one link of said plurality of  
5 links to said another link when said failure is detected on said one link.

1           13.    The system according to claim 6, wherein said receiver switch  
2 further comprises a receiver line card coupled to said second end of each link of  
3 said plurality of links.

1           14.    The system according to claim 13, wherein said receiver line card  
2 further comprises a receiver multiplexing module coupled to each link of said  
3 plurality of links, for merging said cells received on each link of said plurality  
4 of links and a receiver classifier module coupled to said receiver multiplexing  
5 module, for classifying and outputting said cells to a plurality of receiver  
6 queuing buffers.

1           15.    The system according to claim 14, wherein said receiver line card  
2 further comprises a receiver processor for monitoring each link of said plurality  
3 of links and for instructing said transmitter processor of said failure of said one  
4 link.

1           16.    The system according to claim 5, wherein each cell comprises a  
2 transmission header having a virtual circuit identifier (VCI).

1           17.    The system according to claim 5, wherein each cell comprises a  
2 transmission header having a virtual path identifier (VPI).

1           18.    The system according to claim 1, wherein each link of said  
2   plurality of links includes a total bandwidth and provides a guaranteed  
3   bandwidth to a user.

1           19.    The system according to claim 18, wherein said total bandwidth of  
2   each link of said plurality of links is greater than a sum of said guaranteed  
3   bandwidth provided by any two links of said plurality of links.

1           20.    The system according to claim 1, wherein said transmitter switch  
2   further comprises a plurality of transmitter line cards, each transmitter line card  
3   being coupled to said first end of a corresponding link of said plurality of links.

1           21.    The system according to claim 20, wherein said distinct data  
2   transmitted along each link of said plurality of links comprises cells.

1           22.    The system according to claim 21, wherein each transmitter line  
2   card of said plurality of transmitter line cards further comprises a transmitter  
3   classifier module for classifying said cells transmitted along each corresponding  
4   link, a plurality of transmitter queuing buffers coupled to said classifier module  
5   for receiving and storing said cells, and a transmitter multiplexing module  
6   coupled to each buffer of said plurality of queuing buffers and to said  
7   corresponding link of said plurality of links for directing said cells stored in one  
8   buffer of said plurality of queuing buffers to said corresponding link and said  
9   cells stored in all remaining buffers of said plurality of queuing buffers to a  
10   disposal bin.

1           23.    The system according to claim 22, wherein said transmitter switch  
2   receives a virtual connection setup request and assigns at least one virtual  
3   connection corresponding to said virtual connection setup request alternatively  
4   to each buffer of said plurality of transmitter queuing buffers.

1           24.    The system according to claim 23, wherein said at least one virtual  
2 connection is associated with said cells transmitted along each link of said  
3 plurality of links.

1           25.    The system according to claim 23, wherein said transmitter switch  
2 assigns said at least one virtual connection to each buffer of said plurality of  
3 transmitter queuing buffers in such a way so as ensure that each link has a  
4 balanced load.

1           26.    The system according to claim 24, wherein said transmitter  
2 classifier module allocates said cells to each buffer of said plurality of  
3 transmitter queuing buffers based on association with said at least one virtual  
4 connection, in such a way so as to ensure that each link has a balanced load.

1           27.    The system according to claim 22, wherein each buffer of said  
2 plurality of transmitter queuing buffers includes a plurality of Quality of  
3 Service (QoS) category queues.

1           28.    The system according to claim 22, wherein each of said  
2 transmitter line cards further comprises a transmitter processor for monitoring  
3 each link of said plurality of links and for programming said transmitter  
4 multiplexing module to switch said cells directed to said disposal bin to said  
5 corresponding link when said failure is detected.

1           29.    The system according to claim 22, wherein said receiver switch  
2 further comprises a plurality of receiver line cards, each receiver line card being  
3 coupled to said second end of a corresponding link of said plurality of links.

1           30.    The system according to claim 29, wherein each receiver line card  
2 of said plurality of receiver line cards further comprises a receiver multiplexing  
3 module coupled to said second end of said corresponding link of said plurality  
4 of links for receiving said cells, and a receiver classifier module coupled to said  
5 receiver multiplexing module for classifying and outputting said cells to a  
6 plurality of receiver queuing buffers.

1           31.    The system according to claim 30, wherein each receiver line card  
2 of said plurality of receiver cards further comprises a receiver processor for  
3 monitoring said corresponding link, for detecting a failure of said  
4 corresponding link, and for instructing said transmitter processor  
5 corresponding to said link of said failure.

1           32.    A method for protecting a network comprising:  
2           providing a plurality of links between a transmitter switch and a receiver  
3 switch located within said network;  
4           transmitting distinct data from said transmitter switch on each link of  
5 said plurality of links;  
6           switching said distinct data transmitted along one link said plurality of  
7 links to another link of said plurality of links when a failure is detected on said  
8 one link; and  
9           receiving said distinct data to said receiver switch within said network.

1           33.    The method according to claim 32, wherein said network is an  
2 Asynchronous Transfer Mode (ATM) network.

1           34.    The method according to claim 32, wherein said network is a  
2 Frame Relay network.

1           35.    The method according to claim 32, wherein said distinct data  
2 transmitted along each link of said plurality of links comprises cells.

1           36.    The method according to claim 35, further comprising:  
2           receiving a virtual connection setup request; and  
3           assigning at least one virtual connection corresponding to said virtual  
4 connection setup request alternatively to each buffer of a plurality of  
5 transmitter queuing buffers in said transmitter switch.

1           37.    The method according to claim 36, wherein said at least one  
2 virtual connection is associated with said cells transmitted along each link of  
3 said plurality of links.

1           38.    The method according to claim 36, further comprising assigning  
2 said at least one virtual connection to each buffer of said plurality of transmitter  
3 queuing buffers in such a way so as to ensure that each link has a balanced load.

1           39.    The method according to claim 37, further comprising:  
2           classifying said cells within said transmitter switch;  
3           storing said cells within said plurality of transmitter queuing buffers;  
4 and  
5           directing said cells stored in each buffer of said plurality of transmitter  
6 queuing buffers in a predetermined order to a corresponding link of said  
7 plurality of links.

1           40.    The method according to claim 39, wherein, in said storing, said  
2 cells are alternatively stored in each buffer of said plurality of transmitter  
3 queuing buffers.

1           41.    The method according to claim 39 further comprising, in said  
2 storing, allocating said cells to each buffer of said plurality of transmitter  
3 queuing buffers based on association with said at least one virtual connection,  
4 in such a way so as to ensure that each link has a balanced load.

1           42.    The method according to claim 35, further comprising monitoring  
2 each link of said plurality of links for failure and programming a multiplexing  
3 module to switch said plurality of cells directed to said one link of said plurality  
4 of links to said another link when said failure is detected on said one link.

1           43.    The method according to claim 35, further comprising:  
2 merging said cells received on each link of said plurality of links;  
3 classifying said cells; and  
4 outputting said cells to a plurality of receiver queuing buffers.

1           44.    The method according to claim 32, wherein each link of said  
2 plurality of links includes a total bandwidth and provides a guaranteed  
3 bandwidth to a user.

1           45.    The method according to claim 44, wherein said total bandwidth  
2 of each link of said plurality of links is greater than a sum of said guaranteed  
3 bandwidth provided by any two links of said plurality of links.

1           46.    A system for protecting a network, comprising:  
2 a first link and a second link located in said network;  
3 a transmitter switch, coupled to one end of said first link and said second  
4 link, for transmitting distinct data along said first link and said second link;  
5 a receiver switch coupled to another end of said first link and said  
6 second link, for receiving said distinct data;



7 wherein said distinct data transmitted along said first link is switched to  
8 said second link when a failure is detected on said first link.

1 ~~47.~~ A method for protecting a network, comprising:  
2 providing a first link and a second link between a transmitter switch and  
3 a receiver switch located in said network;  
4 transmitting distinct data from said transmitter switch on said first link  
5 and said second link;  
6 switching said distinct data transmitted along said first link to said  
7 second link when a failure is detected on said first link; and  
8 receiving said distinct data to said receiver switch within said network.

1 ~~48.~~ A transmitter switch for protecting a network comprising:  
2 at least one input line card for receiving data in said network; and  
3 a transmitter line card coupled to said at least one input line card;  
4 said transmitter line card coupled to each link of a plurality of links in  
5 said network;  
6 said transmitter line card transmitting distinct cells of said data along  
7 each link of said plurality of links and switching said distinct cells transmitted  
8 along one link to another link when a failure is detected on said one link.

1 49. The transmitter switch according to claim 48, wherein said  
2 network is an Asynchronous Transfer Mode (ATM) network.

1 50. The transmitter switch according to claim 48, wherein said  
2 network is a Frame Relay network.

1 51. The transmitter switch according to claim 48, wherein said  
2 transmitter line card further comprises a transmitter classifier module for  
3 classifying said cells transmitted along said each link of said plurality of links, a

4 plurality of transmitter queuing buffers coupled to said classifier module, for  
5 receiving and storing said cells, and a transmitter multiplexing module coupled  
6 to each buffer of said plurality of transmitter queuing buffers and to each link of  
7 said plurality of links for directing said cells stored in each buffer in a  
8 predetermined order to a corresponding link of said plurality of links.

1 52. The transmitter switch according to claim 51, wherein at least one  
2 virtual connection corresponding to a received virtual connection setup request  
3 is assigned alternatively to each buffer of said plurality of transmitter queuing  
4 buffers.

1 53. The transmitter switch according to claim 52, wherein said at least  
2 one virtual connection is associated with said cells transmitted along each link  
3 of said plurality of links.

1 54. The transmitter switch according to claim 52, wherein said at least  
2 one virtual connection is assigned to each buffer of said plurality of transmitter  
3 queuing buffers in such a way so as to ensure that each link has a balanced load.

1 55. The transmitter switch according to claim 53, wherein said  
2 transmitter classifier module allocates said cells to each buffer of said plurality  
3 of transmitter queuing buffers based on association with said at least one  
4 virtual connection, in such a way so as to ensure that each link has a balanced  
5 load.

1 56. The transmitter switch according to claim 51, wherein each buffer  
2 of said plurality of transmitter queuing buffers further includes a plurality of  
3 Quality of Service (QoS) category queues.

1           57.    The transmitter switch according to claim 51, wherein said at least  
2 one transmitter line card further comprises a transmitter processor for  
3 monitoring each link of said plurality of links and for programming said  
4 transmitter multiplexing module to switch said distinct cells transmitted along  
5 said one link of said plurality of links to said another link when said failure is  
6 detected on said one link.

1           58.    A transmitter switch for protecting a network comprising:  
2           at least one input line card for receiving data in said network; and  
3           a plurality of transmitter line cards coupled to said at least one input line  
4 card;  
5           each transmitter line card being coupled to a corresponding link of a  
6 plurality of links in said network;  
7           each transmitter line card transmitting distinct cells of said data along  
8 each link of said plurality of links and switching said distinct cells transmitted  
9 along one link to another link when a failure is detected on said one link.

1           59.    The transmitter switch according to claim 58, wherein said  
2 network is an Asynchronous Transfer Mode (ATM) network.

1           60.    The transmitter switch according to claim 58, wherein said  
2 network is a Frame Relay network.

1           61.    The transmitter switch according to claim 58, wherein each  
2 transmitter line card of said plurality of transmitter line cards further comprises  
3 a transmitter classifier module for classifying said cells transmitted along said  
4 corresponding link of said plurality of links, a plurality of transmitter queuing  
5 buffers coupled to said classifier module, for receiving and storing said cells,  
6 and a transmitter multiplexing module coupled to each buffer of said plurality  
7 of transmitter queuing buffers and to said corresponding link of said plurality

8 of links for directing said cells stored in one buffer of said plurality of queuing  
9 buffers to said corresponding link and said cells stored in all remaining buffers  
10 to a disposal bin.

1 62. The transmitter switch according to claim 61, wherein at least one  
2 virtual connection corresponding to a received virtual connection setup request  
3 is assigned alternatively to each buffer of said plurality of transmitter queuing  
4 buffers.

1 63. The transmitter switch according to claim 62, wherein said at least  
2 one virtual connection is associated with said cells transmitted along each link  
3 of said plurality of links.

1 64. The transmitter switch according to claim 62, wherein said at least  
2 one virtual connection is assigned to each buffer of said plurality of transmitter  
3 queuing buffers in such a way so as to ensure that each link has a balanced load.

1 65. The transmitter switch according to claim 63, wherein said  
2 transmitter classifier module allocates said cells to each buffer of said plurality  
3 of transmitter queuing buffers based on association with said at least one  
4 virtual connection, in such a way so as to ensure that each link has a balanced  
5 load.

1 66. The transmitter switch according to claim 61, wherein each buffer  
2 of said plurality of transmitter queuing buffers further includes a plurality of  
3 Quality of Service (QoS) category queues.

1 67. The transmitter switch according to claim 61, wherein each  
2 transmitter line card further comprises a transmitter processor for monitoring  
3 each link of said plurality of links and for programming said transmitter

4 multiplexing module to switch said cells directed to said disposal bin to said  
5 corresponding link when said failure is detected.

1 68. A method for protecting a network comprising:  
2 receiving data in said network;  
3 transmitting distinct cells of said data along each link of a plurality of  
4 links in said network; and  
5 switching said distinct cells transmitted along one link to another link  
6 when a failure is detected on said one link.

1 69. The method according to claim 68, wherein said network is an  
2 Asynchronous Transfer Mode (ATM) network.

1 70. The method according to claim 68, wherein said network is a  
2 Frame Relay network.

1 71. The method according to claim 68, further comprising:  
2 receiving a virtual connection setup request; and  
3 assigning at least one virtual connection corresponding to said virtual  
4 connection setup request alternatively to each buffer of a plurality of  
5 transmitter queuing buffers.

1 72. The method according to claim 71, wherein said at least one  
2 virtual connection is associated to said cells transmitted along each link of said  
3 plurality of links.

1 73. The method according to claim 71, further comprising assigning  
2 said at least one virtual connection to each buffer of said plurality of transmitter  
3 queuing buffers in such a way so as to ensure that each link has a balanced load.

1 74. The method according to claim 72, further comprising:  
2 classifying said cells;  
3 storing said cells within each buffer of said plurality of transmitter  
4 queuing buffers; and  
5 directing said cells stored in said each buffer in a predetermined order to  
6 a corresponding link of said plurality of links.

1 75. The method according to claim 74, wherein, in said storing, said  
2 cells are alternatively stored within said each buffer.

1 76. The method according to claim 74, further comprising, in said  
2 storing, allocating said cells to said each buffer based on association with said at  
3 least one virtual connection, in such a way so as to ensure that said link has a  
4 balanced load.

1 77. The method according to claim 68, further comprising monitoring  
2 each link for failure and programming a multiplexing module to switch said  
3 cells directed to said one link to said another link when said failure is detected  
4 on said one link.

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